USER'S MANUAL

LONWORKS® Option Board

SV9000 AF Drive

Subject to changes without notice

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1. INTRODUCTION

1.1 General

SV9000 drives can be connected to a LONWORKS® network using the SV9NCLCN option board kit. The drive can then be controlled, monitored and programmed from the LONWORKS® network.

The LonWorks® option board can also extend the used I/O:
- 4 digital inputs (standard signals)
- 4 digital outputs (standard signals)
- thermistor input (can be directly connected to the motor thermistors for overtemperature trip)
- Encoder input

The interface board must be installed in the external option enclosure outside the drive.

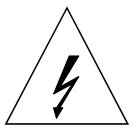
1.2 About this manual

The purpose of this manual is to provide you with the information how to install and set up your SV9000 LONWORKS® Option Board for communication over a LONWORKS® network. For more specific information on installation and operation of the SV9000 refer to the SV9000 Drive User's Manual and SV9000 Fieldbus Application User's Manual.

This manual assumes that you are familiar with the SV9000 drive and are using the LONWORKS® Option Board with a SV9000 drive using the application for fieldbus support. It is also assumed that you are familiar with LONWORKS® and its installation procedures and tools.

1.3 Safety Precautions

Before starting the installation, carefully read all warnings and safety instructions in the SV9000 Drive User's Manual.



Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the SV9000 is connected to the utility. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.

The control I/O terminals are isolated from the utility potential, but the I/Os (if jumper X9 is in OFF-position) may have a dangerous voltage connected even if the power is off on SV9000.

SPECIFICATIONS

Bus Interface connections	Channel	FTT-10A Free Topology transceiver
	Transfer cable	Twisted pair
I/O -control connections	Digital input (4 pcs)	24 V (± 15 %), R_i = 5 kΩ
	Digital output (4 pcs)	Open collector output, 50 mA/48 V
	thermistor input (1 pcs)	R_{trip} = 4.7 kΩ
	Encoder input (3 pcs)	24 V (± 30 V): "0" ≤10 V, "1" ≥18 V, R_i = 3.3 kΩ 5 V (± 10 V): "0" ≤2 V, "1" ≥3 V, R_i = 330 Ω
	Aux. voltage	24 V (±20%), max 50 mA
Safety		Fulfills EN50178 standard

Table 1-1. Specifications

The control connections are isolated from the utility potential and the I/O ground is connected to the frame of the device via a 1 MΩ resistor and a 4.7 nF capacitor*. The control I/O ground can also be connected directly to the frame by changing the position of jumper X9 (GND ON/OFF) to the ON-position. Digital inputs are isolated from the I/O ground.

* Default value (X9 is in the GND OFF- position)

2. LonWorks®

2.1 Overview

Echelon Corporation has developed LonWorks® technology. LONWORKS® network is used for applications in industry and building automation, controlling household electronics, medical instrumentation and many others. The goal of the LONWORKS® network is to provide a common vendor independent communication network for intelligent devices.

In a LONWORKS® network, no central control or master-slave architecture is needed. Nodes on a network communicate with each other using the LonTalk® protocol. Interoperable nodes use Standard Network Variable Types (SNVT) for communicating over the network. The definition of an SNVT includes units, a range, and an increment. SV9000 LONWORKS® uses only Standard Network Variable Types as data types.

All network variables are either input (data comes from the network to the device) or output (data is sent to the network from the device) network variables. When network variables on different nodes on the network have been bound together by an installation tool, passing of data is automatic between the right nodes. Only the same type of network variables can be bound together, so it is very important to have compatible interfaces.

2.2 Physical media and wiring

LONWORKS® networks can be implemented on many different physical media. SV9000 SV9NCLW option board is equipped with an FTT-10A transceiver supporting the Free Topology transformer coupled network, which allows the network wire to be connected as bus, star, loop or mixed. Communication speed with this media is 78kBits/s. The FTT-10A transceiver is compatible with Echelon's LPT-10 Link Power Transceiver, and these transceivers can communicate with each other on a single twisted pair cable.

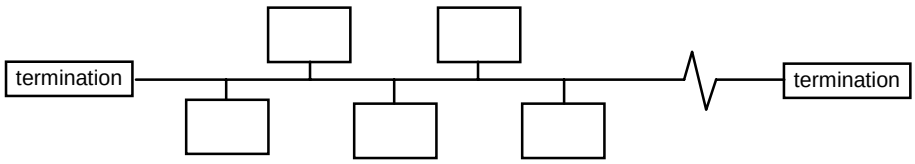


Figure 2-1 Doubly Terminated Bus Topology

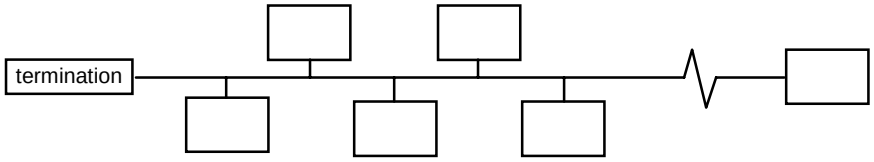


Figure 2-2 Singly Terminated Bus Topology

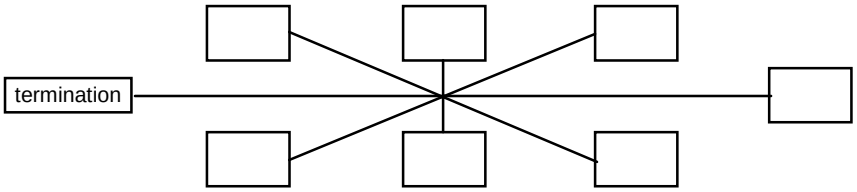


Figure 2-3 Star Topology

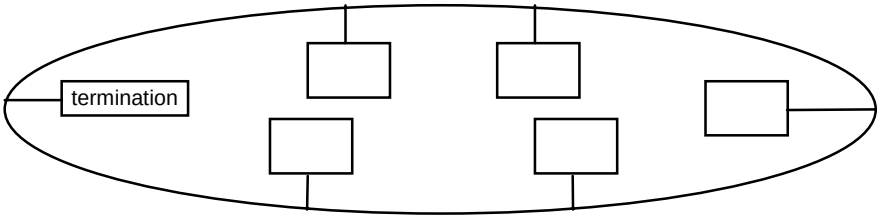


Figure 2-4 Loop Topology

Up to 64 FTT-10 transceiver nodes are allowed per network segment, the individual segments can be connected together by a router. See table 3-1 for recommended cable types and cable lengths for FTT-10. Even though unshielded cable types are recommended to be used with this type of transceiver, it is still highly recommended to use only shielded cables with drives. Attention should be paid to proper grounding of the shield to ensure bus operation, grounding of the shield should be done on both ends of the cable.

Cable type	Max. doubly terminated bus length	Max. free topology wire length	Max. node-to-node distance
Belden 85102 (unshielded)	2700 m	500 m	500 m
Belden 8471 (unshielded)	2700 m	500 m	400 m
Level IV, 22AWG (unshielded)	1400 m	500 m	400 m
JY (St) Y 2x2x0.8mm **(shielded)**	900 m	500 m	320 m

Table 2-1 FTT-10 wiring

2.3 Bus termination

The FTT-10 network segment requires termination for proper data transmission performance. A total termination impedance of approximately 52.3Ω is required.

In a free topology segment, only one termination is required and may be placed anywhere on the free topology segment. In a doubly terminated bus topology, two terminations are required, one at each end of the bus.

The SV9000 SV9NCLW option board is equipped with termination resistors, which can be selected by jumper X6. If the jumper is in the ‘ST’ position single termination is selected and if it is in ‘DT’ double termination is selected. If termination is not done at this node the jumper should be removed or positioned so that it is connected to one pin only.

2.4 Service button and LED

Every LONWORKS® device has a service button, which is needed during network installation. Pressing the button causes the node to send its unique ID number to the network. Because the SV9000 LONWORKS® Option Board is located under drive's cover in normal use, the service button operation can be done by changing the value of a service button parameter from 0 to 1 or vice versa on the SV9000 operating panel. The location of the service button parameter depends on the used SV9000 application.

Each LONWORKS® device should also have a service LED on it. The LED shows the operating state of the device by blinking. On SV9000 the operating state can be seen on the operating panel as actual value 22. See table 3-2 for coding of the states.

Node State	State Code	Service LED
Applicationless and Unconfigured	3	On
Unconfigured	2	Flashing
Configured	4	Off

Table 2-1 Service LED states

3. INSTALLATION

Before starting the installation, carefully read the safety instructions in the " SV9000 Drive User's Manual" chapter “SAFETY”. Check that you have recieved all the LONWORKS® kit parts: Repeater board on mounting board, power cable (black terminal), data cable (blue terminal) and LONWORKS® board in the separate option enclosure.
Repeater board with mounting board can be installed in the existing option board place inside the drive (see figure 4-1).

A	Remove the control panel and the jumper X4 from the control board. Install the jumper that you removed from terminal X4 of the control board, on terminal X9 of the Fieldbus board in the ON or OFF position.
B	Connect the power cable to terminal X5 of the control board and the data cable to terminal X14. The power cable can also be connected to terminal X6 if the power cable from the power board is connected to terminal X5.
C	Put the data and power cables through the holes in the mounting board.
D	Install the mounting board on the standoffs by the larger holes and push it into the right position in the slots on the standoffs . Check that the mounting board is stable and secure it with a screw to the lower left standoff. If you have difficulties to place the board, slightly bend regulator A4 and capacitor C59 of the control board.
E	Connect the power cable to terminal X1 of the Repeater board and the data cable to terminal X2.
F	Connect the cable coming out of the option enclosure to terminal X3 of the repeater board. **Find the closest grounding terminal on the drive and strip the cable so that you can ground the shield under the grounding terminal**.
G	After this install the control panel back in its place.

H	If you use a 5 V encoder input, install the jumper in terminal X7 (see figure 5-1) of the LONWORKS® board

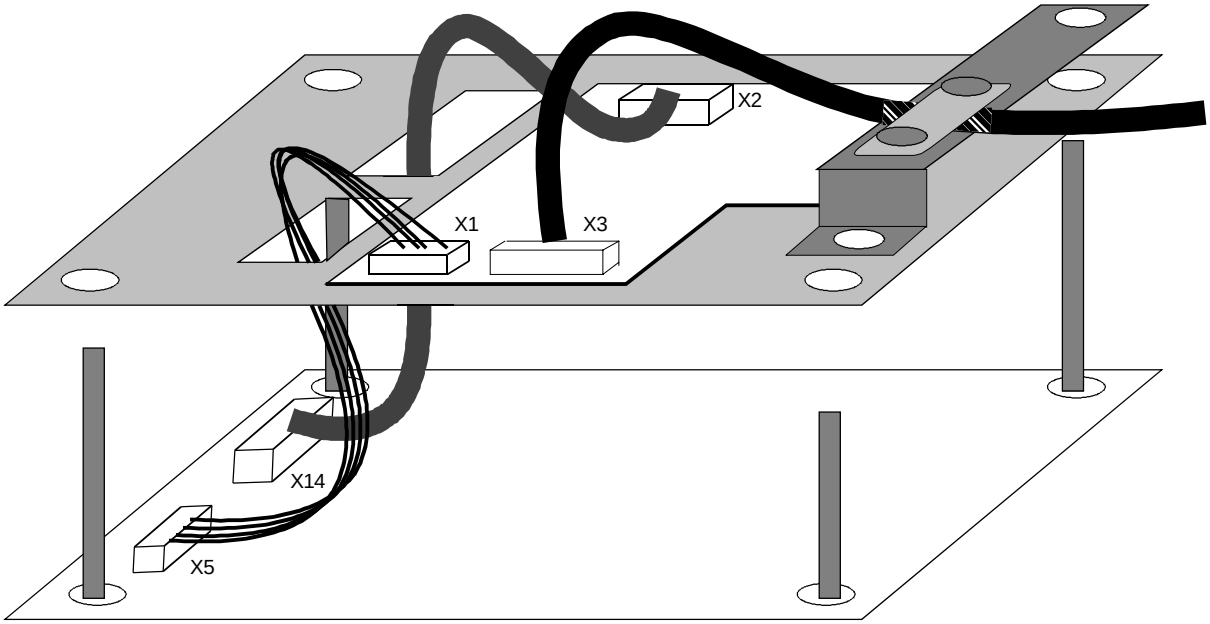
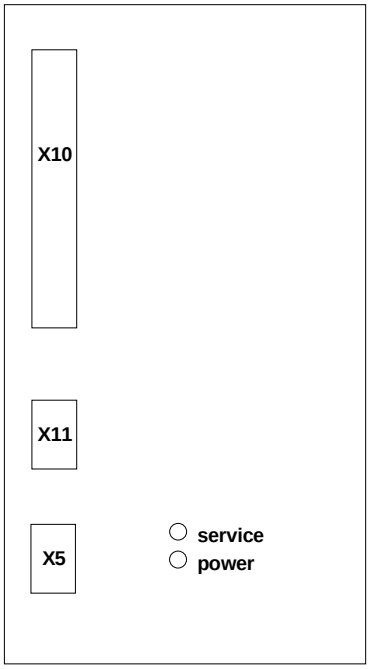


Figure 3-1. Repeater board on mounting board installed on top of the control board

4. CONNECTIONS

4.1 Board layout



Terminals:

X10	I/O - terminals
X11	thermistor input
X5	LONWORKS® network

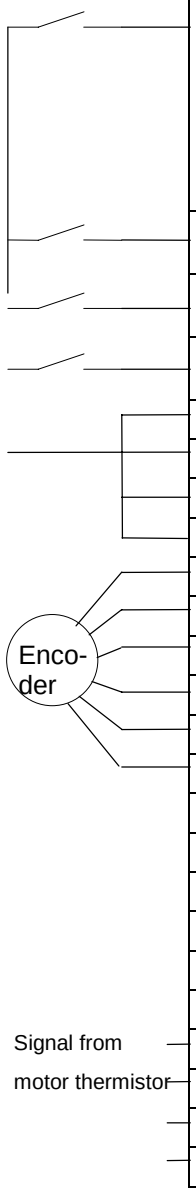
Figure 4-1. LONWORKS® option board

Diagnostic LED:

power Supply Voltage, Green.
Power led is active if the interface board has supply voltage.

service Neuron's service pin, Green.
See table 3-2. for operation of this led.

4.2 I/O-control connections



Terminal		Signal	Description
301	DID1	Programmable: External fault OR Select of Active Control Source	 Contact open = no fault Contact closed = fault Contact open = SV9000 IO-terminal Contact closed = Fieldbus
302	DID2	Run disable	Contact open = start of motor enabled Contact closed = start of motor disabled
303	DIE3	Acceler. / Decel. time selection	Contact open = time 1 selected Contact closed = time 2 selected
304	DIE4	Jogging speed selection	Contact open = no action Contact closed = jogging speed
305	COMD	Common for DID1-DID2	Connect to GND or +24 V
306	+24 V	Control voltage output	Voltage for switches, etc. max. 0.05 A
307	COME	Common for DIE3-DIE4	Connect to GND or +24 V
308	GND	I/O ground	Ground for reference and controls
309	DID5A+	Pulse input A	
310	DID5A-	(differential input)	
311	DID6B+	Pulse input B	90 degrees phase shift compared
312	DID6B-	(differential input)	to pulse input A
313	DID7Z+	Pulse input Z	one pulse per one revolution
314	DID7Z-	(differential input)	
315	GND	I/O ground	Ground for reference and controls
316	DOD1	Open collector output 1	READY
317	DOD2	Open collector output 2	RUN
318	DOD3	Open collector output 3	FAULT
319	DOD4	Open collector output 4	FIELDBUS CONTROL
320	GND	I/O ground	Ground for reference and controls
327	TI+	thermistor input	
328	TI-		
329	NET1	LONWORKS® network	
330	NET2		

Figure 4-1. Control connections

NOTE! thermistor input(terminals 327 and 328) must be shorted if not used.

READY = ON, when the utility voltage has been applied and the SV9000 is ready to operate
RUN = ON, when the motor is running
FAULT = ON, if a fault occurs

5. COMMISSIONING

First read how to commission the drive in the SV9000 Drive User's Manual (Chapter 8.)

Commissioning of the LONWORKS® option board:

1. Check that Fieldbus Application is selected.
   - Parameter P0.1 = 0 (Fieldbus Appl)
2. Change service pin parameter value (Parameter P9.14) from 0 to 1 or vice versa. Check if your Network Management Tool receives a service pin message from SV9000.

Start-up test:

DRIVE APPLICATION

1. Check that the control panel is not the active control source. (See SV9000 Drive User's Manual, Chapter 7.)
2. Set parameter Fieldbus control (P9.1) to value 1 (On).

NETWORK MANAGEMENT SOFTWARE

1. Write value ON to nviStartSto.
2. Drive status is RUN
3. Write 50.00% to nviFreqRef.
4. nviActFreq is 50.00% and drive output frequency is 0.5 x max. frequency.
5. Write value OFF to nviStartSto.
6. Drive status is STOP

If nvoDrvStats bit 3 = 1 Status of drive is FAULT.

6. SV9000 LONWORKS® INTERFACE

6.1 Network Variables

The SV9000 has a predefined set of network variables. These are divided into Network Input variables, Network Output variables and Network Configuration variables.

6.1.1 Network Input variables in the SV9000

Function	Variable Name	SNVT type	Min. Value	Max. Value
Frequency reference	nviFreqRef	SNVT_lev_percent	0.00%	100.00%
PI-control actual value	nviPIconAct	SNVT_lev_percent	0.00%	100.00%
Start/Stop	nviStartSto	SNVT_lev_disc	Stop	Start
Direction of rotation	nviDirectio	SNVT_lev_disc	Forward	Reverse
Reset fault	nviRstFault	SNVT_lev_disc	n/a	Reset
Minimum frequency	nviMinFreq	SNVT_freq_hz	0.0Hz	120/500Hz
Maximum frequency	nviMaxFreq	SNVT_freq_hz	0.0Hz	120/500Hz
Acceleration time	nviAccelTim	SNVT_time_sec	0.1s	3000s
Deceleration time	nviDecelTim	SNVT_time_sec	0.1s	3000s
Clear kWh trip counter	nviClrEnrgy	SNVT_lev_disc	n/a	Clear
Any parameter	nviParIn	SNVT_count	0	65535*)

Table 6-1 Network input variables

*) depends on the selected parameter

nviFreqRef
When fieldbus control in SV9000 has been selected, it follows this network input variable as the frequency reference. This value is the percentage of the frequency area between the set minimum and maximum frequency.

nviPIconAct
This network input variable is used only with a PI-control application with fieldbus support. This variable is the actual value from the process to be controlled by the drive's PI-control.

nviStartSto
When fieldbus control in SV9000 has been selected, this network input variable controls the starting and stopping of the drive. When the value is set different from 0, the SV9000 will start using the selected start function and when the value is set to 0 the SV9000 will stop using the selected stop function.

nviDirectio
When fieldbus control in SV9000 has been selected, this network input variable controls the direction of rotation. Value 0 is forward and any other value sets the rotation to reverse.

nviRstFault
Setting a non-0 value to this variable will reset the active fault in SV9000. This variable will automatically go back to value 0 after the fault has been reset.

nviMinFreq
Defines the minimum frequency for SV9000. If the value is changed via the network it is not saved in the drive's non-volatile memory, unless bit 0 in nciEeprSave has been set to 1.

nviMaxFreq
Defines the maximum frequency for SV9000. If the value is changed via the network it is not saved in the drive's non-volatile memory, unless bit 1 in nciEeprSave has been set to 1.

nviAccelTim
Defines the acceleration time for SV9000. If the value is changed via the network it is not saved in the drive's non-volatile memory, unless bit 2 in nciEeprSave has been set to 1.

nviDecelTim
Defines the deceleration time for SV9000. If the value is changed via the network it is not saved in the drive's non-volatile memory, unless bit 3 in nciEeprSave has been set to 1.

nviClrEnrgy
Giving a non-zero value to this variable clears the SV9000's resettable energy consumption counter.

nviParIn
This network input variable can be used to write a value to any of the SV9000's parameters. Network configuration variable nciParInPt defines the parameter that will be written. If the value is changed via the network it is not saved in the drive's non-volatile memory, unless bit 4 in nciEeprSave has been set to 1.

6.1.2 Network Output variables from the SV9000

Function	Variable Name	SNVT type	Min. Value	Max. Value
Actual frequency	nvoActFreq	SNVT_lev_percent	0.00%	100.00%
Actual motor current	nvoMtrCurnt	SNVT_amp	0.0A	3276.7A**)
Actual motor power	nvoMtrPwr	SNVT_lev_percent	0.00%	163.83%
kWh trip counter	nvoDrvEnrgy	SNVT_elect_kwh	0kWh	65535kWh
Status word	nvoDrvStats	SNVT_state	n/a	n/a
Active fault code	nvoActFault	SNVT_count	0	41
Any parameter	nvoParOut	SNVT_count	0	65535*)

Table 6-1 Network output variables

*) depends on the selected parameter
**)depends on drive nominal current

nvoActFreq
This network output variable's value is the SV9000's output frequency in percent of the frequency area between the set minimum and maximum frequency. Two configuration variables control when this value is propagated to the network.

nvoMtrCurnt
This network output variable's value is the SV9000's output current. Configuration variable nciCurrDlta controls when this value is propagated to the network.

nvoMtrPwr
This network output variable's value is the SV9000's output power in percent of its nominal power. Configuration variable nciPwrDelta controls when this value is propagated to the network.

nvoDrvEnrgy
This network output variable's value is the SV9000's resettable energy consumption counter. The maximum value for used SNVT is 65535 kWh, on the drive the value can go much higher. If the counter exceeds the SNVT's maximum value, the network variable stays at its maximum. In such cases the real value can be seen on the SV9000's control panel. Configuration variable nciEnrgyDlt controls when this value is propagated to the network.

nvoDrvStats
This network output variable represents the status of the SV9000 as a set of 16 boolean values.

Bit	Name	Description
0	Ready	0 = not ready, 1 = ready to start
1	Running	0 = stopped, 1 = running
2	Direction	0 = forward, 1 = reversed
3	Faulted	0 = OK, 1 = faulted
4	Not used	
5	Not used	
6	Not used	
7	Not used	
8	Fieldbus control	0 = external IO or panel, 1 = fieldbus control
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

Table 6-2 Status word bits

nvoActFault
This network output variable's value is the SV9000's active fault code. If the value is 0 the drive has no fault. See the fault code list in the SV9000 Drive User's Manual for identifying the faults.

nvoParOut
This network output variable can be used to read the value of any SV9000 parameter or variable. Network configuration variable nciParIOutPt defines the parameter which will be read.

6.1.3 Network Configuration variables to the SV9000

Function	Variable Name	SNVT type
Time out	nciMaxRcvTm	SNVT_time_sec
Maximum time sending actual frequency value	nciActSndTm	SNVT_time_sec
Amount of change in actual frequency before it is sent	nciActDelta	SNVT_lev_percent
Amount of change in motor current before it is sent	nciCurrDlta	SNVT_amp
Amount of change in motor power before it is sent	nciPwrDelta	SNVT_lev_percent
Amount of change in kWh before it is sent	nciEnrgyDlt	SNVT_elec_kwh
Amount of change in output parameter before it is sent	nciParDelta	SNVT_count
Input parameter's address	nciParInPt	SNVT_count
Output parameter's address	nciParOutPt	SNVT_count
Save the parameter changes from Lon to drive's eeprom	nciEeprSave	SNVT_state

Table 6-1 Network configuration variables

nciMaxRcvTm
The LONWORKS® Option Board will initiate bus-time-out activities when the max. receive time has expired without receiving an input network variable. Action taken by the drive depends on the setting of the fieldbus fault response parameter. The communication watchdog function is disabled when this network configuration variable is set to 0.

nciActSndTm
This network configuration variable sets the maximum time between transmissions of nvoActFreq, so it can be used as a heartbeat to monitor the operation of the network connection. The maximum send time function is disabled when this network configuration variable is set to 0.

nciActDelta
This network configuration variable sets how much nvoActFreq's value has to change before it is transmitted. When this network configuration variable is set to 0, nvoActFreq is not transmitted, unless nciActSndTm is set.

nciCurrDlta
This network configuration variable sets how much nvoMtrCurnt's value has to change before it is transmitted. When this network configuration variable is set to 0, nvoMtrCurnt will not be transmitted.

nciPwrDelta
This network configuration variable sets how much nvoMtrPwr's value has to change before it is transmitted. When this network configuration variable is set to 0, nvoMtrPwr will not be transmitted.

nciEnrgyDlt
This network configuration variable sets how much nvoDrvEnrgy's value has to change before it is transmitted. When this network configuration variable is set to 0, nvoDrvEnrgy will not be transmitted.

nciParDelta
This network configuration variable sets how much nvoParOut's value has to change before it is transmitted. When this network configuration variable is set to 0, nvoParOut will not be transmitted.
nciParInPt
This network configuration variable sets the address of the parameter written by nviParIn. The address is formed from the group and the parameter number, defined by the application in the drive. The group number is multiplied by 100 and the parameter number is added to it. For example the parameter 3 in group 4 has the address 403.

nciParOutPt
This network configuration variable sets the address of the parameter or variable, which is read in nviParOut. The address is formed from the group and parameter number, defined by the application in the drive. The group number is multiplied by 100 and the parameter number is added to it. Group number 0 is used for actual value variables.

nciEeprSave
This network configuration variable is a bit mask, which defines if some of the network input variables are written to SV9000's non-volatile memory, when changed from network. If a bit is set to 1, the corresponding variable will be saved.

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